Introduction

Chapter Overview

Within the U.S. civilian workforce, a group generically referred to as "scientists and engineers" consists of people educated in science (including life, physical, social, computer, and mathematical sciences) and engineering (S&E) and people who, although not educated in these fields, hold S&E occupations. This varied workforce includes technicians and technologists, researchers, educators, and managers of the S&E enterprise. Although these workers make up only a small fraction (less than 5 percent) of the total U.S. civilian workforce, their effect on society belies their number—scientists and engineers contribute enormously to technological innovation and economic growth, scientific and engineering research, and a greater understanding of S&E.

Chapter Organization

This chapter first presents a profile of the U.S. S&E workforce, including workforce size and various employment characteristics. Information on the sex and racial or ethnic composition of the S&E workforce is provided, followed by a description of labor market conditions for recent bachelor's, master's, and doctoral S&E degree recipients. Discussions on the effects of age and retirement on the S&E workforce and the projected demand for S&E workers over 2000–10 are presented. The chapter concludes by examining the global S&E workforce and the migration of scientists and engineers to the United States.

Profile of the U.S. S&E Workforce

Data in this section are from the National Science Foundation's (NSF's) Scientists and Engineers Statistical Data System (SESTAT), which is a unified database containing information on the employment, education, and demographic characteristics of scientists and engineers in the United States.[1]

How Large Is the U.S. S&E Workforce?

Estimates of the size of the U.S. S&E workforce vary based on the criteria used to define a scientist or engineer. See sidebar, "Who Is a Scientist or Engineer?" Education, occupation, field of degree, and field of employment are all factors that may be considered.[2] For example, should any employee with an S&E education be considered a member of the S&E workforce, or should only someone employed in an S&E occupation be considered? In 1999, more than 13 million people in the United States either had an S&E education or were working as scientists or engineers. (See appendix table 3-2.) The number of college-degreed individuals in S&E fields in 1999 exceeded the number of individuals working in S&E occupations because many S&E degree-holders were not working in S&E fields. Also, many individuals who held S&E occupations were educated in fields not considered science or engineering.

Basic Characteristics

Including those either trained or working as scientists or engineers, approximately 13 million[3] scientists and engineers were residing in the United States as of April 1999. However, only 84 percent (nearly 11 million) of these individuals were in the workforce. (See text table 3-1.) The remaining individuals were either unemployed but seeking work (193,200) or not in the workforce (1.86 million).

Of the nearly 11 million individuals trained or working as scientists and engineers in the United States in 1999, the vast majority (almost 10.5 million) had at least one college degree in an S&E field. About 30 percent (3.3 million) of the almost 10.5 million S&E degree-holders in the workforce were also employed in S&E occupations. The remaining one-half million individuals had college degrees in non-S&E fields but were currently or had been previously employed in S&E occupations. See sidebar, "Growth of the S&E Workforce."

What Do People Do With an S&E Education?

Many U.S. scientists and engineers have multiple S&E degrees or have degrees in both S&E and non-S&E fields. Many S&E-educated workers also routinely find S&E-related employment in occupations not included within traditional S&E classifications. In 1999, of the 10.5 million S&E degree-holders in the workforce, about three-fourths (almost 8 million) reported that their highest degrees were in S&E fields. (See text table 3-1.) However, many of these individuals (approximately 5 million) were not employed principally in a science or engineering occupation.

Although the majority of S&E degree-holders do not work in S&E occupations, their S&E training does not necessarily go to waste. Of the 5 million S&E degree-holders perform-

[1]SESTAT data are collected from three component surveys sponsored by NSF (*National Survey of College Graduates, National Survey of Recent College Graduates,* and *Survey of Doctorate Recipients*) and conducted periodically throughout each decade. SESTAT's target population is U.S. residents who hold bachelor's degrees or higher (in either an S&E or a non-S&E field) who, as of the study's reference period, were noninstitutionalized, not older than age 75, and either trained or working as a scientist or engineer (e.g., either had at least one bachelor's degree or higher in an S&E field or had a bachelor's degree or higher in a non-S&E field and worked in an S&E occupation during the reference week. For the 1999 SESTAT, the reference period was the week of April 15, 1999.

[2]For a detailed discussion of the S&E degree fields and occupations in SESTAT, see NSF 1999a. A list of S&E occupations and fields is contained in appendix table 3-1. In general, S&E occupations and fields in this report include those in the field of social sciences and exclude medical practitioners and technicians (including computer programmers). Thus, a physician with an M.D. will not be considered to be "S&E" either by occupation or by highest degree, but he is likely (but not certainly) to be included in statistics that incorporate those with S&E degrees based on their field of bachelor's degree.

[3] This number includes all those who received a bachelor's degree or higher in an S&E field plus those holding a non-S&E bachelor's degree or higher who were employed in an S&E occupation during either the 1993, 1995, 1997, or 1999 SESTAT surveys.

Who Is a Scientist or Engineer?

The terms "scientist" and "engineer" have many definitions—none of which are perfect. For a more thorough discussion of these complexities, see *SESTAT and NIOEM: Two Federal Databases Provide Complementary Information on the Science and Technology Labor Force* (NSF 1999e) and "Counting the S&E Workforce—It's Not That Easy" (NSF 1999b). Multiple definitions are used for analytic purposes in this report, and even more are used in reports elsewhere. Three main definitions used in this report are as follows:

- **Occupation.** The most common way to count scientists and engineers in the workforce is to include those having an occupational classification that matches some list of science and engineering (S&E) occupations. Although considerable questions can arise regarding how well individual write-ins or employer classifications are coded, the occupation classification comes closest to defining the work a person performs. An engineer, by occupation, may or may not have an engineering degree, but correct classification will show that worker as doing engineering work. One limitation of classifying by occupation is that it will not capture individuals using S&E knowledge, sometimes extensively, under occupational titles such as manager, salesman, or writer.* It is common for a person with a science or engineering degree in such occupations to report that his or her work is closely related to his degree and, in many cases, also report research and development (R&D) as a major work activity.
- **Highest degree.** Another way to classify scientists and engineers is to focus on the field of their highest (or most recent) degree. For example, classifying as "chemist" a person who has a bachelor's degree in chemistry but works as a technical writer for a professional chemists' society magazine—may be appropriate. Using this "highest degree earned" classification does not solve all problems, however. For example, should a person with a bachelor's degree in biology and a master's degree in engineering be included among biologists or engineers? Should a person with a bachelor's degree in political science be counted among social scientists if he also has a law degree? Classifying by highest degree earned in situations similar to the above examples may be appropriate, but one may be uncomfortable excluding an individual who has a bachelor's degree in engineering and also a master's degree in business administration from an S&E workforce analysis.
- **Anyone with an S&E degree or occupation.** Another approach is to classify by both occupation and education. National Science Foundation sample surveys of scientists and engineers attempt to include those residing in the United States who have either a science or an engineering degree or occupation.†

*In most collections of occupation data, a generic classification of postsecondary teacher fails to properly classify many university professors who would otherwise be included by most definitions of the S&E workforce. Scientists and Engineers Statistical Data System (SESTAT) data mostly avoids this problem.

†Individuals who lacked a U.S. S&E degree but who earned an S&E degree from another country are included in 1999 SESTAT data to the extent they were in the United States in 1990, 1993, 1995, 1997, and 1999, as were those who had at least a bachelor's degree in some field and who were working in an S&E occupation in 1993, 1995, 1997, and 1999.

ing non-S&E jobs in 1999, 67.3 percent indicated that they were employed in a field at least somewhat related to the field of their highest S&E degrees.[4] (See text table 3-2.) Almost 80 percent of those whose highest earned degrees were in mathematics or computer sciences and who were employed in non-S&E jobs were working in fields related to their degrees compared with 63 percent of those whose highest earned degrees were in social and physical sciences.

Of all employed individuals whose highest degrees were in S&E, 76.8 percent said their jobs were related to the fields of their highest degrees, and 45.7 percent said their jobs were closely related to their fields.[5] (See appendix tables 3-8 and 3-9.) The relatedness of a field of study to an individual's job varies in ways that are mostly predictable by level, years since earning, and field of degree.

In the one- to four-year period after receiving their degrees, 73 percent of S&E doctorate-holders say that they have jobs closely related to the degrees they received compared with 67.4 percent of master's recipients and 42 percent of bachelor's recipients. (See figure 3-2.) This relative ordering of relatedness by level of degree holds across all periods of years since the recipients received their degrees. However, at every degree level, jobs held by degree recipients generally are less closely related to the field of degree earned.[6] There may be good reasons for this: individuals may change their career interests over time, gain skills in different areas while working, take on general management responsibilities, and forget some of their original college training—or some of

[4]Refers to highest degree received.

[5]Although these self-assessments by survey respondents are highly subjective, they may capture associations between training and scientific expertise not evident through occupational classifications. For example, an individual with an engineering degree but an occupational title of salesman may still use or develop technology.

[6]Ph.D.-holders of more than 25 years are an exception; the percentage of those holding jobs closely related to their degrees increases. This disparity may reflect differences in retirement rates.

Text table 3-1.
Employed scientists and engineers, by S&E employment status and field of highest degree: 1999

Employee characteristic	Employment status		
	Total	S&E	Non-S&E
Total employed	10,981,600	3,540,800	7,440,800
No S&E degree	501,800	282,000	219,800
S&E degree	10,479,800	3,258,800	7,221,000
S&E is highest degree	7,980,000	3,003,200	4,976,800
Computer sciences and mathematics	1,045,800	537,200	508,600
Life and related sciences	1,287,700	361,700	926,000
Physical and related sciences	621,700	343,000	278,700
Social and related sciences	3,088,400	458,000	2,630,400
Engineering	1,936,400	1,303,300	633,100
Non-S&E is highest degree	2,499,800	255,600	2,244,200

NOTE: Details may not add to totals because of rounding.

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1999.

Science & Engineering Indicators – 2002

their original college training may become obsolete. Given these possibilities, the career-cycle decline in the relevance of an S&E degree is modest.

When comparing 1993 data with 1999 data (see figure 3-3), each year demonstrates the same general pattern. However, given the better labor market conditions in 1999, a somewhat higher proportion of midcareer (10–24 years since receiving degree) S&E bachelor's degree-recipients and doctorate-holders said in 1999 that their jobs were closely related to their degrees. At the bachelor's degree level, an additional 11.5 percent of those who had received their degrees 15–19 years prior were in jobs closely related to their field of study. For Ph.D. recipients, the improvement was much smaller (4.7 percent) for those 20–24 years after receiving their degrees.

Differences in the percentages of those who said their jobs were closely related to their fields of degree are shown in figure 3-4 by level of degree and in figure 3-5 by major S&E disciplines for bachelor's recipients. Although mathematics and computer sciences are often combined into a single group, they are shown separately here because of their very different patterns. From one to four years after receiving their degrees, the percentage of S&E bachelor's degree-recipients who said their jobs were closely related to fields of degree earned ranged greatly—from 30.0 percent for those whose degree was in social sciences to 74.3 percent for those whose degree was in computer sciences. Between these extremes, most other S&E fields show similar percentages for recent graduates: 54.1 percent for physical sciences, 51.8 percent for mathematics, 54.9 percent for engineering, and 44.2 percent for life sciences.

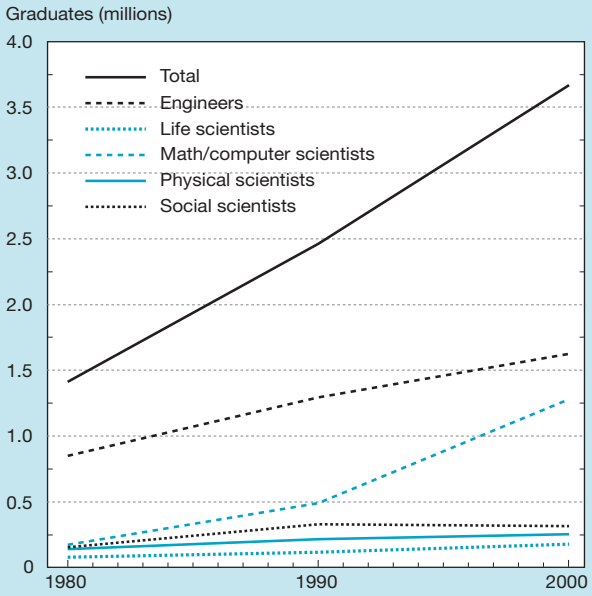
Growth of the S&E Workforce

Although Scientists and Engineers Statistical Data System data for the 1990s demonstrate limitations of using only occupation to measure the scope of the science and engineering (S&E) workforce, we depend on occupation classifications to examine S&E growth over extended time periods. By looking only at college graduates working in narrowly defined S&E occupations (excluding technicians and computer programmers) and employed outside academia,* S&E jobs increased by 159 percent between 1980 and 2000, totaling 3,664,000 nonacademic S&E occupations in 2000. (See figure 3-1.) This represents a 4.9 percent average annual growth rate, much more than the 1.1 percent average annual growth rate of the entire labor force.

Although every broad S&E occupational group grew between 1980 and 2000 (the lowest growth, 81 percent, occurred in physical sciences), the most explosive growth was in mathematics and computer sciences, which experienced a 623 percent increase (177,000 jobs in 1980 to 1,280,000 jobs in 2000).

*Another difficulty when using occupation to identify scientists and engineers in most data sources other than NSF/SRS's SESTAT is that many in academia are identified simply as "college professor" or by similar titles that do not indicate specialty. For that reason, the time trend examined here is only for those outside academic employment.

Figure 3-1.
College graduates in nonacademic S&E occupations



SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), tabulation of 1980 and 1990 U.S. Decennial Census Public Use Microdata Sample, March 2000 Current Population Survey.

Science & Engineering Indicators – 2002

Text table 3-2.
People with S&E degrees who are employed in non-S&E occupations, by highest degree and relation of degree to job: 1999

Highest degree	Total in non-S&E occupations	Highest degree related to job (percent)		
		Closely	Somewhat	Not
Total[a]	4,976,900	33.2	34.1	32.7
Bachelor's ...	4,092,800	29.9	34.7	35.5
Master's	724,800	48.7	31.2	20.1
Doctorate	155,200	46.0	35.6	18.5

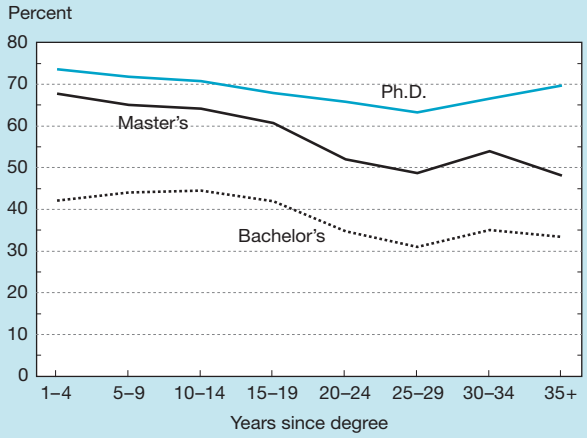
[a]Includes professional degrees.

NOTE: Details may not add to totals because of rounding.

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1999.

Science & Engineering Indicators – 2002

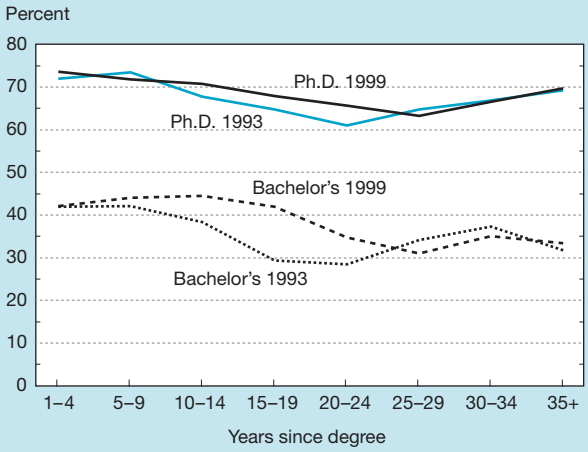
Figure 3-2.
Employed S&E degree-holders in jobs closely related to highest degree: 1999



SOURCE: National Science Foundation/Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1999.

Science & Engineering Indicators – 2002

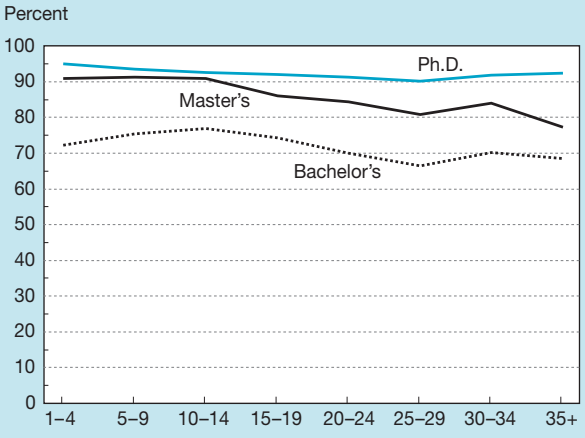
Figure 3-3.
Employed S&E degree-holders, in job closely related to highest degree, by years since degree: 1993 and 1999



SOURCE: National Science Foundation/Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT),1993 and 1999.

Science & Engineering Indicators – 2002

Figure 3-4.
Employed S&E degree-holders in jobs related to highest degree: 1999



SOURCE: National Science Foundation/Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1999.

Science & Engineering Indicators – 2002

Employment in Non-S&E Occupations

Slightly more than one-half of the 5 million S&E degree-holders working outside S&E in 1999 held management or administrative occupations (28 percent), sales and marketing jobs (15 percent), or non-S&E-related teaching positions (9 percent). (See text table 3-3.) Almost 89 percent of non-S&E teachers said that their work was at least somewhat related to their S&E degrees compared with 73 percent of managers or administrators and almost 51 percent of those employed in sales and marketing jobs.

Almost 82 percent of the 5 million S&E degree-holders not working in S&E occupations in 1999 reported their highest degree to be a bachelor's degree; 15 percent listed a master's degree, and 3 percent listed a doctorate. Approximately two-thirds of those with a bachelor's degree reported their jobs to be closely related to their highest degree field compared with four-fifths of doctoral and master's S&E degree recipients.

Employment in S&E Occupations

Of the 8 million scientists and engineers in the workforce in 1999 whose highest degree earned was in an S&E field, slightly more than one-third (3 million) were principally em-

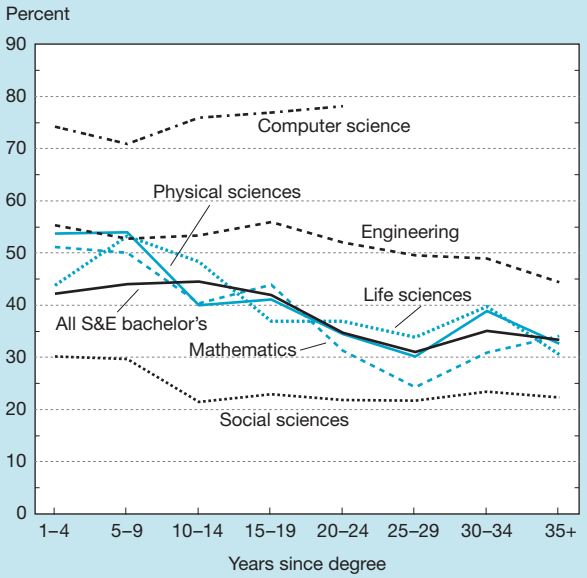
ployed in S&E jobs. Additionally, 256,000 people trained in S&E whose highest degree was in a non-S&E field were employed in S&E occupations. Also, 282,000 college-educated individuals were employed in S&E occupations yet held no degrees in an S&E field.

Altogether, approximately 3.5 million individuals held S&E occupations in 1999. (See appendix table 3-10.) Engineers represented 39 percent (1.37 million) of the S&E positions, and computer scientists and mathematicians represented 33 percent (1.17 million). Physical scientists accounted for less than 9 percent of those working in S&E occupations in 1999.

By subfield, electrical engineers made up about one-fourth (362,000) of all those employed as engineers, whereas biologists accounted for about three-fifths (206,000) of employment in life sciences. In physical and social science occupations, chemists (122,000) and psychologists (197,000) were the largest occupational subfields, respectively.

Almost 56 percent of those employed in S&E jobs reported their highest degree earned to be a bachelor's degree, whereas 29 percent listed a master's degree and 14 percent listed a doctorate. About 1 percent reported other professional degrees to be their highest degree earned. Almost one-half of bachelor's degree-recipients were engineers; slightly more than one-third were computer scientists and mathematicians. (See text table 3-4.) These occupations were also the most popular among those with master's degrees (approximately 37 and 34 percent, respectively). Most doctorate-holders were employed as social scientists (26 percent), life scientists (25 percent), and physical scientists (18 percent).

Figure 3-5.
Employed S&E bachelor's degree-holders in job closely related to degree: 1999



SOURCE: National Science Foundation/Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT). 1999.

Science & Engineering Indicators – 2002

Unemployment

Of the approximately 3.6 million individuals with S&E occupations in the labor force in 1999, only 1.6 percent (56,000) were unemployed.[7] (See text table 3-5.) This compares with 4.4 percent for the 1999 U.S. labor force as a whole and 1.9 percent for all professional specialty workers. Unemployment for those with S&E occupations has dropped steadily since 1993, when it stood at 2.6 percent. The highest unemployment rate in 1999 was for physical scientists (1.9 percent), and the lowest rate was for computer scientists and

[7] The unemployment rate is the ratio of those who are unemployed and seeking employment to the total labor force (i.e., those who are employed plus those who are unemployed and seeking employment). Those who are not in the labor force (those who are unemployed and not seeking employment) are excluded from the denominator.

Text table 3-3.
People with S&E as highest degree who are employed in non-S&E occupations, by occupation and relation of degree to job: 1999

Occupation	Number	Highest degree related to job (percent)		
		Closely	Somewhat	Not
Total non-S&E occupations	4,976,900	33.2	34.1	32.7
Managers and administrators	1,416,000	30.0	43.0	27.0
Health related	322,200	58.1	27.1	14.7
Non-S&E teachers	452,400	65.8	22.7	11.5
Non-S&E postsecondary teachers	50,000	68.1	23.7	8.2
Social services	291,500	61.2	28.7	10.0
Technologists and technicians	337,600	46.6	34.1	19.3
Sales and marketing	764,400	13.3	37.5	49.2
Arts and humanities	122,500	21.7	38.1	40.2
Other	1,220,400	20.0	29.2	50.8

NOTE: Details may not add to total because of rounding.

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1999.

Science & Engineering Indicators – 2002

Text table 3-4.
Distribution of individuals in S&E occupations, by level of highest degree: 1999
(Percentages)

Occupation	All degrees	Bachelor's	Master's	Doctorate	Professional
Total	100.0	100.0	100.0	100.0	100.0
Computer scientists and mathematicians	33.0	37.1	34.3	13.9	18.8
Life and related scientists	9.7	6.8	7.0	25.0	42.2
Physical and related scientists	8.4	7.0	7.1	17.5	1.4
Social and related scientists	10.3	3.6	15.1	26.2	30.4
Engineers	38.7	45.5	36.5	17.4	7.2

NOTE: Percentages may not add to 100 because of rounding.

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1999.

Science & Engineering Indicators – 2002

Text table 3-5.
Unemployment rates for individuals in S&E occupations: 1993 and 1999
(Percentages)

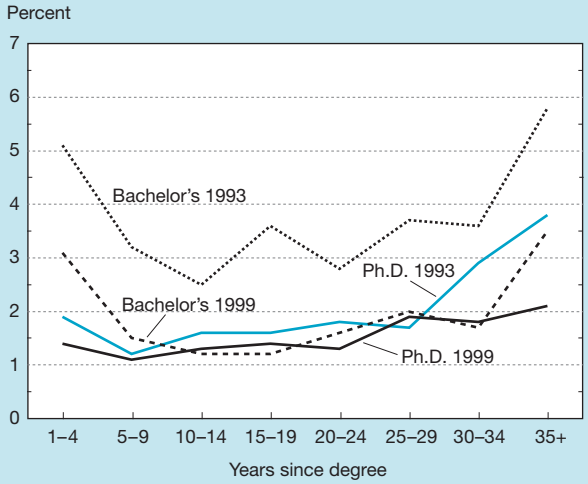
Occupation	1993	1999
All S&E occupations	2.6	1.6
Computer scientists and mathematicians	1.9	1.2
Life and related scientists	1.7	1.3
Physical and related scientists	2.8	1.9
Social and related scientists	1.6	1.4
Engineers	3.4	1.8

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1993 and 1999.

See appendix tables 3-10 and 3-11.

Science & Engineering Indicators – 2002

Figure 3-6.
Unemployment rates for S&E degree-holders by years since highest degree: 1993 and 1999



SOURCE: National Science Foundation/Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT),1993 and 1999.

Science & Engineering Indicators – 2002

mathematicians (1.2 percent). By degree level, 1.6 percent of the scientists and engineers whose highest degree earned was a bachelor's degree were unemployed compared with 1.6 percent of those with a master's degree and 1.2 percent of those with a doctorate.

Unemployment rates during S&E degree-holders' careers are shown in figure 3-6 and indicate 1993 and 1999 rates for bachelor's and doctorate degree-holders. The generally stronger 1999 labor market had its greatest effect on bachelor's degree-recipients: among them, unemployment dropped by about 2 percentage points between 1993 and 1999 for all career levels. Although labor market conditions affect Ph.D. unemployment rates much less, significant reductions in unemployment rates between 1993 and 1999 occurred for Ph.D.-holders at both the beginning and end of their careers.

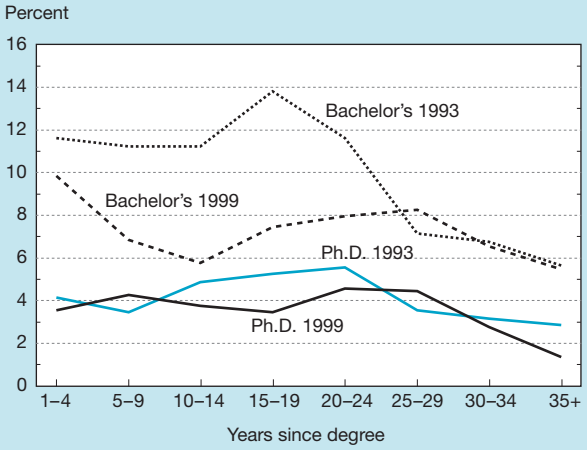
Similarly, labor market conditions from 1993 to 1999 had a greater effect on the portion of bachelor's degree-recipients who said they were working involuntarily outside their field of highest degree (involuntarily out of field, or IOF) than for Ph.D.-holders. (See figure 3-7.) However, the greatest differences in IOF rates for bachelor's degree-recipients occurs not at the beginning and end of one's career, but in midcareer. For Ph.D.-holders, few differences in IOF rates were noted between 1993 and 1999, and little change was noted during their careers.[8]

Sector of Employment

The private, for-profit sector is by far the largest provider of S&E employment. In 1999, approximately 74 percent of scientists and engineers with bachelor's degrees and 62 percent of those with master's degrees were employed in private, for-profit companies. (See appendix table 3-12.) The academic sector was the largest sector of employment for those with doctorates (48 percent). Sectors employing fewer S&E workers included educational institutions other than four-year colleges and universities, nonprofit organizations, and state or local government agencies.

[8] The decline in IOF rates for the oldest doctorate-holders may reflect in part lower retirement rates for those still working in their fields.

Figure 3-7.
Involuntarily out-of-field rates of S&E degree-holders, by years since highest degree: 1993 and 1999



SOURCE: National Science Foundation/Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1993 and 1999.

Science & Engineering Indicators – 2002

For S&E occupations, the percentages of scientists and engineers employed in private, for-profit industry varied greatly. Although slightly more than three-fourths of both computer scientists and mathematicians and engineers (76 and 78 percent, respectively) were employed in this sector, only about one-fourth (27 percent) of life scientists and one-fifth (19 percent) of social scientists were so employed in 1999. Educational institutions employed the largest percentages of life scientists (48 percent) and social scientists (45 percent). See sidebar, "Educational Distribution of S&E Workers."

Who Performs R&D?

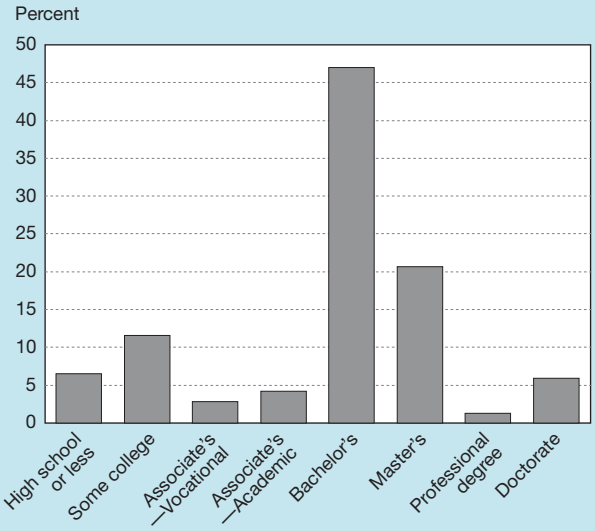
Although S&E-educated individuals use their acquired knowledge in various ways (e.g., teaching, writing, evaluating, and testing), they show a special interest in research and development (R&D). Figure 3-9 shows the distribution of individuals with S&E degrees by level of degree who report R&D as a major work activity. Those with doctorates make up only 5.6 percent of total S&E degrees achieved but represent 14.4 percent of those reporting R&D as a major work activity. Despite this, the majority of S&E degree-holders who report R&D as a major work activity have only bachelor's degrees (55.4 percent). An additional 27.4 percent have master's degrees, and 2.8 percent have professional degrees (mostly in medicine). Figure 3-10 shows the distribution of individuals with S&E degrees by field of highest degree who reported R&D as a major work activity. Those with engineering degrees constitute almost one-third (31.7 percent) of the total. Notably, 17.9 percent did not earn their highest degrees in S&E fields. In most cases, a person in this group has an S&E bachelor's degree and a higher degree in a professional field, such as business, medicine, or law.

Educational Distribution of S&E Workers

In 2000, more than two-thirds of those in nonacademic science and engineering (S&E) occupations had bachelor's degrees (47.0 percent) or master's degrees (20.7 percent). Discussions of the S&E workforce often focus on employees who hold doctorates. However, using United States Current Population Survey data to look at the educational achievement of those in S&E occupations outside academia in 2000, only 5.9 percent had doctorates. (See figure 3-8.)

In contrast, one-fourth of those in S&E occupations had not earned a bachelor's degree. Although technical issues of occupational classification may account for the size of the nonbaccalaureate S&E workforce, it is also true that many individuals who have not earned a bachelor's degree do enter the labor force with marketable technical skills. These skills come from technical or vocational school training (with or without earned associate degrees), college courses, and on-the-job training. In information technology (IT) (and to some extent in other occupations), employers are more frequently using certification exams to judge skills without reference to formal degrees.

Figure 3-8.
Educational distribution of those in nonacademic S&E occupations: 2000

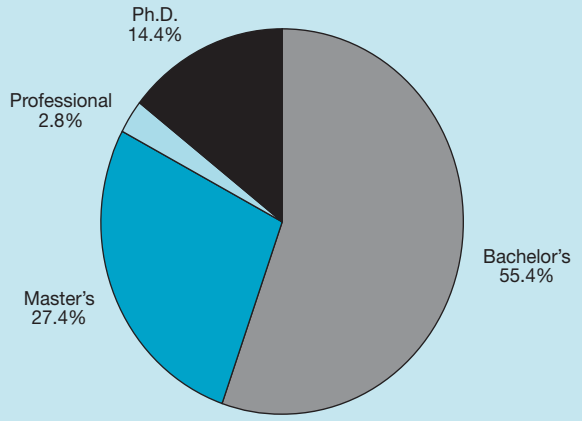


SOURCE: U.S. Department of Commerce/Bureau of the Census, Current Population Survey, March 2000

Science & Engineering Indicators – 2002

The percentages of S&E Ph.D.-holders reporting R&D as a major work activity are shown by field of degree and by years since receipt of Ph.D. in figure 3-11. The highest R&D rates over the career cycle are found in physical sciences and engineering; the lowest R&D rates are in social sciences. Al-

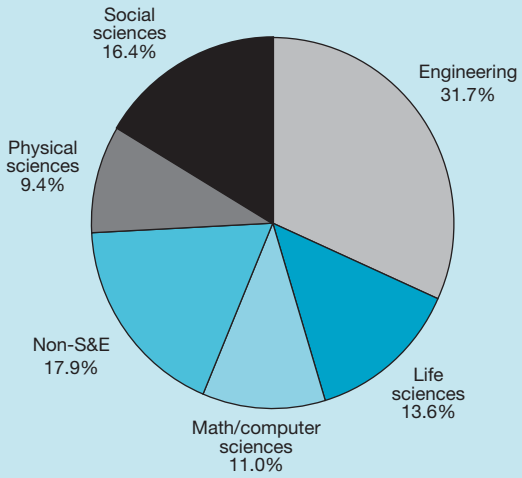
Figure 3-9.
Distribution of S&E R&D workers, by level of degree: 1999



SOURCE: National Science Foundation/Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1999.

Science & Engineering Indicators – 2002

Figure 3-10.
Distribution of S&E R&D workers by field of highest degree: 1999

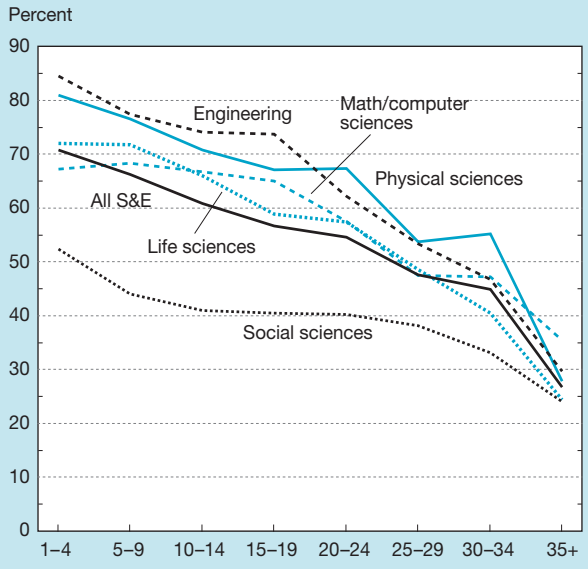


SOURCE: NSF/SRS 1999 Scientists and Engineers Statistical Data System file.

Science & Engineering Indicators – 2002

though the percentage of Ph.D.-holders engaged in R&D declines as years since receipt of degree increase, it remains greater than 50 percent in all fields except social sciences through 25 years since receipt of degree. The decline may reflect a normal career process of movement into management or other career interests.

Figure 3-11.
S&E Ph.D.-holders engaged in R&D as major work activity: 1999



SOURCE: National Science Foundation/Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1999.

Science & Engineering Indicators – 2002

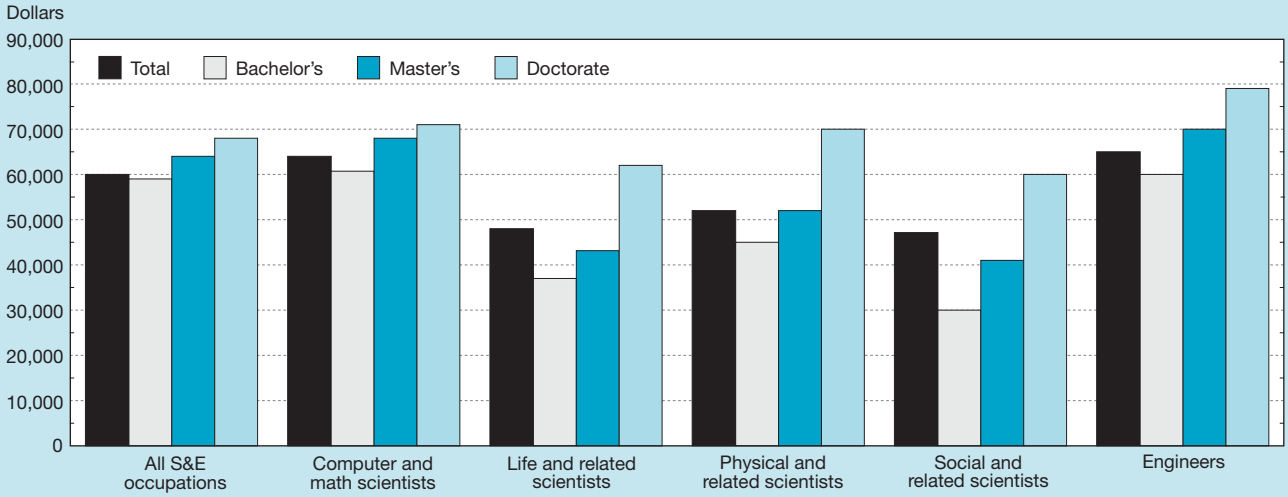
Salaries

In 1999, the median annual salary of employed bachelor's degree-recipients was $59,000; for master's recipients, it was $64,000; and for doctorate-holders, it was $68,000. (See figure 3-12 and appendix table 3-22.) Engineers commanded the highest salaries at the master's and doctorate levels, whereas computer scientists and mathematicians earned the highest salaries at the bachelor's level. The second highest salaries were earned by engineers at the bachelor's level, by computer scientists and mathematicians at the master's level, and by physical scientists at the doctorate level. The lowest median salaries reported were for social scientists at each degree level.

From 1993 to 1999, median salaries for those employed in S&E occupations rose about 25 percent. (See text table 3-6.) Computer scientists and mathematicians experienced the largest salary growth (37 percent), followed by engineers (30 percent). By degree level, median salaries for bachelor's degree-recipients rose by 31 percent, followed by master's degree-recipients (28 percent).

Median salaries for S&E job-holders also rise steadily as years pass from completion of the degree. For example, individuals who earned their bachelor's or doctoral degrees 5–9 years ago earned about $14,000 less in 1999 than those who received their degrees 15–19 years ago. For master's degree-recipients, the difference is $9,000. (See appendix table 3-26.)

Figure 3-12.
Median annual salaries of employed scientists and engineers by broad occupation and highest degree: 1999



See appendix table 3-22.

Science & Engineering Indicators – 2002

Text table 3-6.
Median annual salaries of individuals in S&E occupations, by highest degree attained: 1993–99
(Dollars)

Highest degree	1993	1995	1997	1999
Total S&E	48,000	50,000	55,000	60,000
Bachelor's	45,000	48,000	52,000	59,000
Master's	50,000	53,500	59,000	64,000
Doctorate	54,800	58,000	62,000	68,000

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1993 and 1999.

See appendix tables 3-22, 3-23, 3-24 and 3-25.

Science & Engineering Indicators – 2002

Women and Minorities in S&E

Demographic factors for women and minorities, such as age, time spent in the workforce, field of S&E employment, and highest degree level achieved, influence employment patterns.[9] To the extent that men differ from women and minorities differ from nonminorities on these factors, their employment patterns are also likely to differ. For example, the age distributions of women compared with men and of minorities compared with the majority are quite different. Because many women and minorities have entered S&E fields only recently, women and minority men generally are younger and have fewer years of experience. (See appendix table 3-34.) In turn, age and stage in career influence such employment-related factors as salary, rank, tenure, and work activity. In addition, employment patterns vary by field, and these field differences influence S&E employment, unemployment, salaries, and work activities. Highest degree earned, yet another important influence, particularly affects primary work activity and salary. This section examines the employment characteristics of representation in S&E, work experience, field of S&E, educational background, workforce participation, sectors of employment, and salaries for women and minorities in 1999.

Women Scientists and Engineers

Representation in S&E

Women made up almost one-fourth (24 percent) of the S&E workforce but close to one-half (46 percent) of the U.S. workforce in 1999. Although changes in NSF surveys do not permit analysis of long-term trends in employment, short-term trends reflect an increase in female doctorate-holders employed in S&E. In 1993, women made up 20 percent of the doctoral scientists and engineers in the United States; in 1995, they made up 22 percent; in 1997, they made up 23 percent; and in 1999, they made up 24 percent.[10] See sidebar, "Growth of Representation of Women, Minorities, and the Foreign Born in the S&E Workforce."

Work Experience

Many differences in employment characteristics between men and women are due in part to differences in time spent in the workforce. Women in the S&E workforce are younger on average than men; 50 percent of women and 36 percent of men employed as scientists and engineers in 1999 received their degrees within the past 10 years.

[9] Throughout this section, scientists and engineers are defined by field of employment, not by field of degree.

[10] For 1993 figures, see NSF 1996, p. 63; for 1995 figures, see NSF 1999b, p. 99.

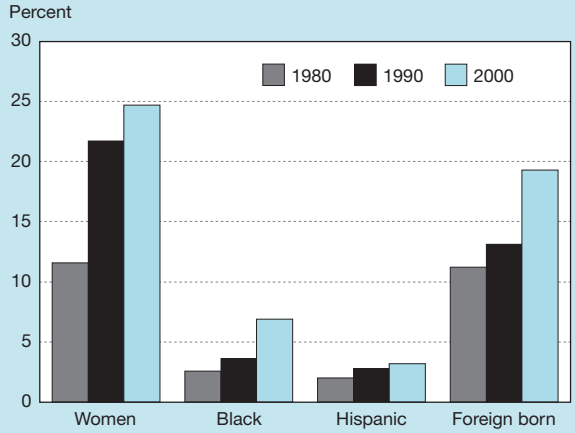
Growth of Representation of Women, Minorities, and the Foreign Born in the S&E Workforce

A longer view of the changes that have occurred in the sex and ethnic composition of the science and engineering (S&E) workforce can be achieved by examining data on college-educated individuals in nonacademic S&E occupations from the 1980 census, the 1990 census, and the March 2000 Current Population Survey. (See figure 3-13.) In 2000, the percentages of historically underrepresented groups in S&E occupations were still lower than the percentages of those groups in the total college-educated workforce:

- Women were 24.7 percent of the S&E workforce but 48.6 percent of the college-degreed workforce.
- Blacks were 6.9 percent of the S&E workforce but 7.4 percent of the college-degreed workforce.
- Hispanics were 3.2 percent of the S&E workforce but 4.3 percent of the college-degreed workforce.

However, these percentages are more than double of the shares of S&E occupations since 1980 for blacks (2.6 to 6.9 percent) and women (11.6 to 24.7 percent). Hispanic representation increased between 1980 and 2000, albeit at a lower rate (2.0 to 3.2 percent). Foreign-born college graduates also became a larger percentage of those in S&E jobs (11.2 percent in 1980 to 19.3 percent in 2000).

Figure 3-13.
College graduates in nonacademic S&E occupations: women and minorities



SOURCE: U.S. Department of Commerce, Bureau of the Census, 1980 and 1990 U.S. Decennial Census Public Use Microdata Sample, and March 2000 Current Population Survey.

Science & Engineering Indicators – 2002

Field of S&E Occupation

As is the case in degree fields, representation of men and women differ in field of occupation. Women are more represented in some S&E fields than in others. For example, in 1999, women made up more than one-half of social scientists but only 23 percent of physical scientists and 10 percent of engineers. (See figure 3-14.) Within engineering, women are represented more in some fields than in others. For example, women constituted 15 percent of chemical and industrial engineers but only 6 percent of aerospace, electrical, and mechanical engineers. Since 1993, the percentages of women in most S&E occupations have gradually increased; the exception is mathematics and computer sciences, in which the percentage of women declined about 4 percent between 1993 and 1999.

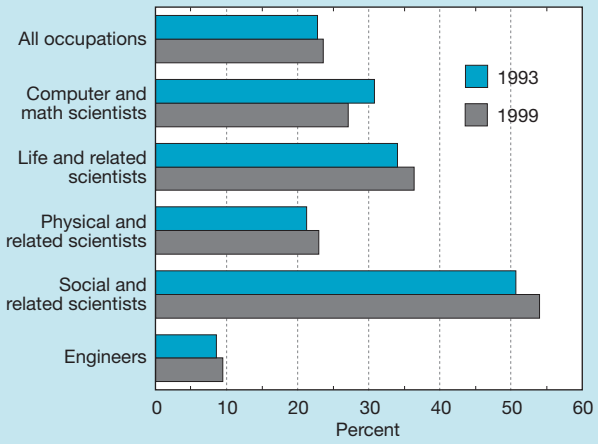
Educational Background

In many occupational fields, women scientists have a lower level of education than men. In the science workforce as a whole, 16 percent of women and 20 percent of men hold doctoral degrees. In biology, 26 percent of women and 40 percent of men hold doctoral degrees; in chemistry, 14 percent of women and 27 percent of men hold doctoral degrees; and in psychology, 22 percent of women and 42 percent of men hold doctoral degrees. Differences in highest degree achieved influence differences in type of work performed, employment in S&E jobs, and salaries. In engineering, the difference is much less: about 5 percent of women and 6 percent of men have doctoral degrees. (See NSF 1999f.)

Labor Force Participation, Employment, and Unemployment

Scientists and engineers who are men are more likely than women to be in the labor force, employed full time, and em-

Figure 3-14.
Women as proportion of S&E workforce, by broad occupation



See appendix tables 3-38 and 3-39.

Science & Engineering Indicators – 2002

ployed in fields of highest degree achieved. Women are more likely than men to be out of the labor force, employed part time, and employed outside their fields. Some of these differences are due to differences in age distributions of men and women, and some are due to family-related reasons, such as the demands of a spouse's job or the presence of children.

The labor force participation rates for men and women with current or former S&E occupations are similar: 88 percent of men and 86 percent of women are in the labor force; the remaining percentages are those not in the labor force (i.e., not working and not seeking employment). (See appendix table 3-38.) Among those in the labor force, unemployment rates for men and women scientists and engineers are similar: 1.5 percent of men and 1.8 percent of women were unemployed in 1999. By comparison, the unemployment rate in 1993 was 2.7 percent for men and 2.1 percent for women. (See text table 3-7.)

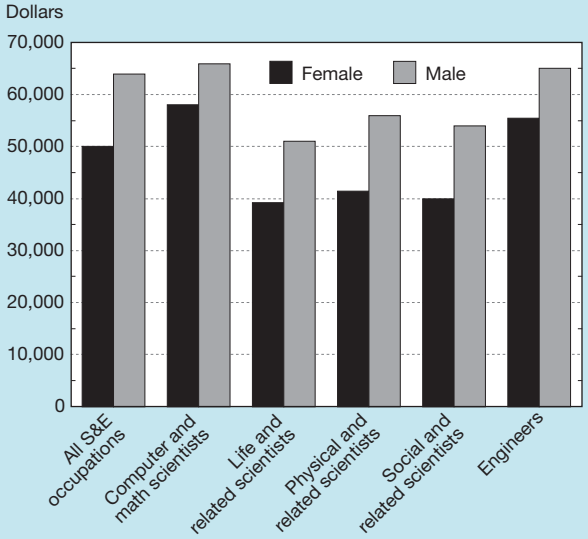
Sector of Employment

Within fields, women are about as likely as men to choose industrial employment. For example, among physical scientists, 55 percent of women and 54 percent of men are employed in business or industry. (See appendix table 3-40.) Among employed scientists and engineers as a whole, women are less likely than men to be employed in business or industry but are more likely to be employed in educational institutions: 51 percent of women and 68 percent of men are employed in for-profit business or industry, but 27 percent of women and 14 percent of men are employed in educational institutions. These differences in sector of employment, however, are due to differences in field of degree. Women are less likely than men to be engineers or physical scientists, who tend to be employed in business or industry.

Salaries

In 1999, the median annual salary for women scientists and engineers was $50,000, about 22 percent less than the median salary for men ($64,000). (See figure 3-15.) Between 1993 and 1999, salaries for women scientists and engineers increased by 25 percent compared with an increase of 28 percent for men. (See text table 3-8.) These salary differentials could be due in part to several factors. Women were more likely than men to be working in educational institutions and social science occupations, to be working in nonmanagerial positions, and to have less experience, all factors that con-

Figure 3-15.
Median annual salaries of employed scientists and engineers, by broad occupation and sex: 1999



See appendix table 3-26. *Science & Engineering Indicators – 2002*

Text table 3-7.
Unemployment rates for individuals in S&E occupations, by sex and race/ethnicity: 1993 and 1999
(Percentages)

Sex and race/ethnicity	1993	1999
S&E occupations, total	2.6	1.6
Sex		
Male	2.7	1.5
Female	2.1	1.8
Race/ethnicity		
White	2.4	1.5
Black	2.8	2.6
Hispanic	3.5	1.8
Asian/Pacific Islander	4.0	1.5
Other	4.8	0.9

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1993 and 1999.

See appendix tables 3-38 and 3-39.

Science & Engineering Indicators – 2002

Text table 3-8.
Median annual salaries of individuals employed in S&E occupations, by sex and race/ethnicity
(Dollars)

Sex and race/ethnicity	1993	1995	1997	1999
S&E occupations, total	48,000	50,000	55,000	60,000
Sex				
Male	50,000	52,000	58,000	64,000
Female	40,000	42,000	47,000	50,000
Race/ethnicity				
White	48,000	50,500	55,000	61,000
Black	40,000	45,000	48,000	53,000
Hispanic	43,000	47,000	50,000	55,000
Asian/Pacific Islander	48,000	50,000	55,000	62,000
Other	43,300	49,700	49,000	52,000

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1993 and 1999.

See appendix tables 3-26, 3-27, 3-28 and 3-29.

Science & Engineering Indicators – 2002

The NSB Task Force on National Workforce Policies for Science and Engineering

In October 2000, the National Science Board established the Task Force on National Workforce Policies for Science and Engineering to assess long-term national workforce trends and needs in S&E and their relationship to existing Federal policies and to recommend strategies that will address long-term S&E workforce needs. The task force will consider the following issues:

- how U.S. demographic trends, trajectories of S&E preparation and degree attainment, and availability of foreign scientists and engineers may affect the future S&E workforce;
- how data on industry demand—both for requisite skills and the numbers of workers who possess them—can better inform preparation, hiring, and retention of students at all levels for high-technology careers;
- how graduate training can be diversified to support aspirations that match opportunities, especially outside of research and of academia, while ensuring continued excellence in the traditional preparation of U.S. scientists and engineers; and
- how the mix of Federal law, such as immigration policy, Federal agency and state programs, higher education institution practices, and employer recruitment and other incentives affect student and worker choices related to S&E careers.

The report of the Task Force on National Workforce Policies For Science and Engineering is expected to be available in 2002. Further information about the work of the task force can be found on the Board's website at http://www.nsf.gov/nsb/.

tribute to salary differences. Among scientists and engineers in the workforce who have held their degrees for five years or less, the median annual salary for women was 83 percent of that for men in 1999.

Salary differentials varied by broad field. In computer science and mathematics occupations in 1999, women's salaries were approximately 12 percent less than men's salaries, whereas there was a 23 percent salary difference in life science occupations. In these respective occupations, women also reported the highest and lowest median salaries; their highest median salary was in computer science and mathematics occupations ($58,000), and their lowest was in life science occupations ($39,000).

Racial and Ethnic Minority Scientists and Engineers

Representation in S&E

With the exception of Asians, minorities make up a small portion of scientists and engineers in the United States.[11] Eleven percent of scientists and engineers in 1999 were Asian, although they constituted 4 percent of the U.S. population. Blacks, Hispanics, and American Indians as a group constituted 24 percent of the U.S. population but only 7 percent of the total S&E workforce in 1999.[12] Blacks and Hispanics each represented about 3 percent of scientists and engineers, and American Indians represented less than 0.5 percent. (See appendix tables 3-41 and 3-44.) Between 1993 and 1999, the portion of Asians in the S&E workforce increased by about 2 percent, whereas the portion of blacks, Hispanics, and American Indians remained virtually unchanged.

Work Experience

The work experience of minorities, including Asians, differs from that of white scientists and engineers. As noted earlier, such differences influence employment characteristics. About 33 percent of white scientists and engineers employed in 1999 had received their degrees within the previous 10 years compared with 46–52 percent of Asian, black, and Hispanic scientists and engineers.

Field of S&E Occupation

Asian, black, and American Indian scientists and engineers are concentrated in fields different from those for white and Hispanic scientists and engineers. Asians are less represented in social sciences than in other fields. In 1999, they were 4 percent of social scientists but more than 11 percent of engineers and computer scientists. Black scientists and engineers have higher representation rates in social sciences and in computer sciences and mathematics than in other fields. In 1999, they were 5 percent of social scientists, 4 percent of computer scientists and mathematicians, and approximately 3 percent of physical scientists, life scientists, and engineers. Although their representation is small, American Indians are concentrated in social sciences, making up 0.4 percent of social and life scientists and 0.3 percent or less of scientists in other fields in 1999. Hispanics are more proportionally represented among fields; they were approximately 2.5 to 4.5 percent of scientists and engineers in each field.

[11] The term "minority" includes all groups other than white; "underrepresented minorities" include three groups whose representation in S&E is less than their representation in the population: blacks, Hispanics, and American Indians/Alaskan Natives. In accordance with Office of Management and Budget guidelines, the racial and ethnic groups described in this section are identified as white and non-Hispanic, black and non-Hispanic, Hispanic, Asian/Pacific Islander, and American Indian/Alaskan Native. In text and figure references, these groups are identified as white, black, Hispanic, Asian, and American Indian.

[12] The S&E fields in which blacks, Hispanics, and American Indians earn their degrees influence participation in the S&E labor force. Blacks, Hispanics, and American Indians are disproportionately likely to earn degrees in social sciences (defined by NSF as degrees in S&E) and to be employed in social service occupations, such as social worker and clinical psychologist, which are defined by NSF as non-S&E occupations. See NSF 1999a for NSF's classification of S&E fields.

Educational Background

The educational achievement of scientists and engineers differs among racial and ethnic groups. On average, black and Hispanic scientists and engineers have a lower level of educational achievement than scientists and engineers of other racial and ethnic groups. A bachelor's degree is more likely to be the highest degree achieved for black and Hispanic scientists and engineers than for white or Asian scientists and engineers—in 1999, a bachelor's degree was the highest degree achieved for 61 percent of black scientists and engineers in the U.S. workforce compared with 56 percent of all scientists and engineers.

Labor Force Participation, Employment, and Unemployment

Labor force participation rates vary by race and ethnicity. Minority scientists and engineers are more likely than whites to be in the labor force (that is, employed or seeking employment). Between 89 and 93 percent of black, Asian, Hispanic, and American Indian scientists and engineers were in the labor force in 1999 compared with 86 percent of white scientists and engineers. (See appendix table 3-38.) Age somewhat explains these differences. On average, white scientists and engineers are older than scientists and engineers of other racial and ethnic groups: 28 percent of white scientists and engineers were age 50 or older in 1999 compared with 15–20 percent of Asians, blacks, and Hispanics. For those in similar age groups, the labor force participation rates of white and minority scientists and engineers are similar. (NSF 1999b.)

Although minorities are for the most part less likely than nonminorities to be out of the labor force, minorities in the labor force are more likely to be unemployed. In 1999, the unemployment rate of white scientists and engineers was somewhat lower than that of other racial and ethnic groups. (See text table 3-7.) The unemployment rate for whites was 1.5 percent compared with 1.8 percent for Hispanics, 2.6 percent for blacks, and 1.5 percent for Asians. In 1993, the unemployment rate for whites was 2.4 percent compared with 3.5 percent for Hispanics, 2.8 percent for blacks, and 4.0 percent for Asians.

The differences in 1999 unemployment rates are evident within fields of S&E as well as for S&E as a whole. For example, the unemployment rate for white engineers was 1.8 percent; for black and Asian engineers, it was 2.3 and 1.8 percent, respectively.

Sector of Employment

Racial and ethnic groups differ within employment sector due in part to differences in field of employment. Among employed scientists and engineers in 1999, 58 percent of blacks, 60 percent of Hispanics, and 56 percent of American Indians were employed in for-profit business or industry compared with 64 percent of white and 70 percent of Asians. (See appendix table 3-40.) Blacks and American Indians are concentrated in social sciences (a field that provides less opportunity for employment in business or industry) and are underrepresented in engineering (a field that provides greater opportunity for employment in business or industry). On the other hand, Asians are overrepresented in engineering; thus, they are more likely to be employed by private, for-profit employers.

Black, Hispanic, and American Indian S&E job-holders are also more likely than other groups to be employed in government (Federal, state, or local): 20 percent of black, 15 percent of Hispanic, and 18 percent of American Indian scientists and engineers were employed in government in 1999 compared with 12 percent of white and Asian scientists and engineers.

Salaries

Salaries for S&E job-holders vary among racial and ethnic groups. In 1999, for all scientists and engineers, the median salaries by racial and ethnic group were $61,000 for whites, $62,000 for Asians, $53,000 for blacks, $55,000 for Hispanics, and $50,000 for American Indians. (See figure 3-16 and text table 3-8.) These salary patterns are about the same as they were in 1993.

Within occupational fields and age categories, median salaries of scientists and engineers by race and ethnicity are not dramatically different and do not follow a consistent pattern. For example, in 1999, the median salary of 20- to 29-year-old engineers with bachelor's degrees ranged from $35,000 for American Indians to $46,000 for Hispanics. Among those between the ages of 40 and 49, the median salary ranged from $60,000 for Asians and Native Americans to $70,000 for whites. The median salary of engineers with bachelor's degrees in 1999 who had received their degrees within the past five years was $45,000 for all ethnicities. (See appendix table 3-26.) Among those who had received their degrees 20–24 years ago, the median salary was approximately $70,000 for all ethnicities. See sidebar, "Salary Differentials."

Labor Market Conditions for Recent S&E Degree-Holders

Recipients of Bachelor's and Master's Degrees

Recent recipients of S&E bachelor's and master's degrees form a key component of the U.S. S&E workforce: they account for almost one-half of the annual inflow to the S&E labor market (NSF 1990).[13] Recent graduates' career choices and entry into the labor market affect the supply and demand

[13] Data for this section are taken from the *1999 National Survey of Recent College Graduates.* This survey collected information on the 1999 workforce status of 1997 and 1998 bachelor's and master's degree recipients in S&E fields. Surveys of recent S&E graduates have been conducted biennially for NSF since 1978. For information on standard errors associated with survey data, see NSF (forthcoming b).